Tetra Tech, Inc.
DATA VALIDATION REPORT
LEVEL IV

Site:	West Lake Landfill Site, Bridgeton, Missouri
Laboratory:	TestAmerica Laboratories, Inc. (Earth City, Missouri)
Data Reviewer:	Harry Ellis, Tetra Tech, Inc. (Tetra Tech)
Review Date	May 9, 2016
Sample Delivery Group (SDG):	J16583
Sample Numbers:	SEDIMENT 2016-03-16A EPA and SEDIMENT 2016-03-16B EPA
Matrix / Number of Samples:	2 Sediment Samples

The data were qualified according to the U.S. Environmental Protection Agency (EPA) Region 7 documents entitled "Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review" (9355.0-131), August 2014. In addition, the Tetra Tech document "Review of Data Packages from Subcontracted Laboratories" (February 2002) and the EPA and others document "Multi-Agency Radiological Laboratory Analytical Protocols Manual" (July 2004) were used along with other criteria specified in the applicable methods.

The review was intended to identify problems and quality control (QC) deficiencies that were readily apparent from the summary data package. The following sections discuss any problems or deficiencies that were found, and data qualifications applied because of non-compliant QC. The data review was limited to the available field and laboratory QC information submitted with the project-specific data package.

I, Harry Ellis, certify that all data validation criteria outlined in the above-referenced documents were assessed, and any qualifications made to the data accorded with those documents.

Harry N. Ellis III

9 May 2016

Certified by Harry Ellis, Chemist — Date

DATA VALIDATION QUALIFIERS

U — The analyte was not detected above the reported sample quantitation limit.

J — The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ — The analyte was not detected above the reported sample quantitation limit, which is estimated.

R — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. Presence or absence of the analyte cannot be verified.

DATA ASSESSMENT

Sample delivery group (SDG) J16583 included two (2) environmental sediment samples and no QC samples. The samples were analyzed for thorium and uranium isotopes by alpha spectroscopy, using DOE Method A-01-R, and for radium-226 and other isotopes by gamma spectroscopy, using EPA Method GA-01-R. The following summarizes the data validation that was performed.

ALPHA SPECTROSCOPY ANALYSES

I. Holding Time and Chain of Custody (COC) Requirements

The samples were received by the laboratory and analyzed within the established holding time of 6 months from sample collection to analysis. No data were qualified.

II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed in these analyses. No qualifications were applied for this data gap. LCS and duplicate analyses provided adequate confirmation of accuracy and precision.

III. Blanks

The laboratory (method) blanks yielded low activities for all thorium isotopes and for uranium-238. The field sample results for thorium-228 were less than 10 times the blank result, so they were qualified as estimated, possibly biased high, and flagged "J". The activities of the other isotopes were more than 10 times the blank activities, so no further qualifications were applied.

IV. Laboratory Control Sample (LCS)

All percent recoveries and relative percent differences from the LCS analyses were within established control limits. No qualifications were applied.

V. Tracers

The tracers (thorium-229 and uranium-232) yielded fully satisfactory recoveries from all samples. No qualifications were applied.

VI. Calibrations and other Quality Control measures

All calibrations (including initial, annual verification, monthly, and daily) were within QC limits. Monthly background checks were also within limits.

VII. Comments

All samples contained rocks and twigs; these items were removed before homogenization. The reported results are representative of the sample portion remaining following removal of the rocks and twigs.

VIII. Overall Assessment of Data

Overall data quality is acceptable, with no significant qualifications applied. All data are usable as qualified for their intended purposes.

GAMMA SPECTROSCOPY ANALYSES

I. Holding Time and Chain of Custody (COC) Requirements

The samples were received by the laboratory and analyzed within the established holding time of 6 months from sample collection to analysis. The preferred 21-day ingrowth period was performed before determination of the radium. No data were qualified.

II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed in these analyses. No qualifications were applied for this data gap. LCS and duplicate analyses provided adequate confirmation of accuracy and precision.

III. Blanks

The laboratory (method) blank yielded no detectable activities of the analytes. No qualifications were applied.

IV. Laboratory Control Sample (LCS)

All percent recoveries from the LCS analyses were within established control limits. No qualifications were applied.

V. Tracers

Tracers are not used in these radioanalytical methods.

VI. Calibrations and other Quality Control measures

All calibrations (including initial, annual verification, monthly, and daily) were within QC limits. Monthly background checks were also within limits.

VII. Comments

All samples contained rocks and twigs; these items were removed before homogenization. The reported results are representative of the sample portion remaining following removal of the rocks and twigs.

VIII. Overall Assessment of Data

Overall data quality is acceptable, with no qualifications applied. All data are usable as reported for their intended purposes.

Client Sample ID: SEDIMENT 2016-03-16A EPA

Date Collected: 03/16/16 13:35
Date Received: 03/17/16 12:45

Lab Sample ID: 160-16583-1
Matrix: Solid

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	1.14	J	0.192	0.214	0.0886	0.0327	pCi/g	03/24/16 13:52	04/01/16 12:04	1
Thorium-230	5.87		0.427	0.652	0.0375	0.00713	pCi/g	03/24/16 13:52	04/01/16 12:04	1
Thorium-232	0.697		0.147	0.159	0.0477	0.0123	pCi/g	03/24/16 13:52	04/01/16 12:04	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*97.8*		*30 - 110*	*03/24/16 13:52*	*04/01/16 12:04*	*1*

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	1.16		0.224	0.244	0.0784	0.0233	pCi/g	03/24/16 13:52	03/31/16 14:04	1
Uranium-235/236	0.0693		0.0654	0.0657	0.0806	0.0205	pCi/g	03/24/16 13:52	03/31/16 14:04	1
Uranium-238	0.953		0.202	0.217	0.0685	0.0184	pCi/g	03/24/16 13:52	03/31/16 14:04	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Uranium-232	*95.5*		*30 - 110*	*03/24/16 13:52*	*03/31/16 14:04*	*1*

Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Actinium-227	0.0451	U	1.00	1.00	1.76	0.820	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Actinium 228	0.518		0.327	0.331	0.561	0.242	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Bismuth-212	0.902		0.987	0.991	1.57	0.662	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Bismuth-214	1.52		0.287	0.327	0.156	0.0606	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Lead-210	4.98		2.62	2.68	2.98	1.37	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Lead-212	0.963		0.250	0.280	0.242	0.112	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Lead-214	1.61		0.301	0.345	0.203	0.0879	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Potassium-40	10.9		2.36	2.61	1.63	0.657	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Protactinium-231	0.0504	U	0.700	0.700	3.98	1.83	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Radium-226	1.52		0.287	0.327	0.156	0.0606	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Radium-228	0.518		0.327	0.331	0.561	0.242	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Thorium-232	0.518		0.327	0.331	0.561	0.242	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Thorium-234	3.27		1.79	1.82	2.95	1.39	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Thallium-208	0.312		0.106	0.111	0.0951	0.0384	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Uranium-235	0.305		0.330	0.331	0.642	0.297	pCi/g	03/23/16 13:33	04/14/16 07:32	1
Uranium-238	3.27		1.79	1.82	2.95	1.39	pCi/g	03/23/16 13:33	04/14/16 07:32	1

Other Detected Radionuclides	*Result*	*Qualifier*	*Count Uncert. (2σ+/-)*	*Total Uncert. (2σ+/-)*	*MDC*	*DLC*	*Unit*	*Prepared*	*Analyzed*	*Dil Fac*
Other Detected Radionuclide	*None*						*pCi/g*	*03/23/16 13:33*	*04/14/16 07:32*	*1*

HWG 9 May 2016

Client Sample ID: SEDIMENT 2016-03-16B EPA

Lab Sample ID: 160-16583-2

Date Collected: 03/16/16 13:55
Matrix: Solid
Date Received: 03/17/16 12:45

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	**0.837**	J	0.163	0.178	0.0773	0.0272	pCi/g	03/24/16 13:52	04/01/16 12:05	1
Thorium-230	**3.85**		0.343	0.471	0.0230	0.00704	pCi/g	03/24/16 13:52	04/01/16 12:05	1
Thorium-232	**0.601**		0.136	0.145	0.0448	0.0110	pCi/g	03/24/16 13:52	04/01/16 12:05	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*98.3*		*30 - 110*	*03/24/16 13:52*	*04/01/16 12:05*	*1*

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	**0.618**		0.164	0.172	0.0826	0.0256	pCi/g	03/24/16 13:52	03/31/16 14:04	1
Uranium-235/236	0.0162	U	0.0380	0.0381	0.0793	0.0202	pCi/g	03/24/16 13:52	03/31/16 14:04	1
Uranium-238	**0.618**		0.162	0.170	0.0636	0.0162	pCi/g	03/24/16 13:52	03/31/16 14:04	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Uranium-232	*89.4*		*30 - 110*	*03/24/16 13:52*	*03/31/16 14:04*	*1*

Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	MDC	DLC	Unit	Prepared	Analyzed	Dil Fac
Actinium-227	-0.129	U	0.642	0.642	1.11	0.520	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Actinium 228	**0.616**		0.281	0.288	0.357	0.154	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Bismuth-212	**0.831**		0.796	0.801	1.25	0.551	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Bismuth-214	**1.11**		0.205	0.235	0.102	0.0404	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Lead-210	**3.00**		1.66	1.69	2.16	1.01	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Lead-212	**0.830**		0.142	0.178	0.133	0.0512	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Lead-214	**1.30**		0.192	0.235	0.179	0.0816	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Potassium-40	**9.11**		1.78	2.01	1.38	0.590	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Protactinium-231	0.226	U	0.559	0.559	2.42	1.12	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Radium-226	**1.11**		0.205	0.235	0.102	0.0404	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Radium-228	**0.616**		0.281	0.288	0.357	0.154	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Thorium-232	**0.616**		0.281	0.288	0.357	0.154	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Thorium-234	**1.32**		1.30	1.31	2.19	1.05	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Thallium-208	**0.335**		0.0968	0.103	0.0712	0.0300	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Uranium-235	0.0721	U	0.237	0.237	0.454	0.213	pCi/g	03/23/16 13:33	04/14/16 07:33	1
Uranium-238	**1.32**		1.30	1.31	2.19	1.05	pCi/g	03/23/16 13:33	04/14/16 07:33	1

Other Detected Radionuclides	*Result*	*Qualifier*	*Count Uncert. (2σ+/-)*	*Total Uncert. (2σ+/-)*	*MDC*	*DLC*	*Unit*	*Prepared*	*Analyzed*	*Dil Fac*
Other Detected Radionuclide	*None*						*pCi/g*	*03/23/16 13:33*	*04/14/16 07:33*	*1*

AWG
9 May 16